Volume 18 Study G-I-D

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

INVENTORY AND CATALOGING AND POPULATION SAMPLING OF THE SPORT FISH AND SPORT FISH WATERS IN UPPER COOK INLET

by

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RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska

Project No.: F-9-9

Study No.: G-I Study Title: INVENTORY AND CATALOGING

Job No.: G-I-D Job Title: Inventory, Cataloging and Population Sampling of the Sport Fish and Sport Fish Waters in Upper Cook Inlet

Period Covered: July 1, 1976 to June 30, 1977

ABSTRACT

Minnow trapping was conducted in the Big Lake watershed to determine life history of salmonids. Minnow traps were fished a combined total of 8,200 hours during summer and winter. Highest catch rates occurred during the winter which may have been related to differing trapping conditions during the two seasonal periods. Catch rates indicate that salmonid population densities in lotic environments remain relatively equal throughout the year in the Big Lake watershed, although seasonal shifts of various age groups do occur within the drainage. Highest salmonid densities occurred in Fish Creek in the area immediately below Big Lake which may be due to a velocity barrier at the Big Lake control structure.

Age I+ rainbow trout, Salmo gairdneri Richardson, showed migrational tendencies in Fish Creek during late summer. It appeared that age II+ rainbow trout migrated from lotic to lentic environments during late summer.

A large variation in coho salmon, Oncorhynchus kisutch (Walbaum), fry lengths were noted throughout the survey period. Average lengths of all ages of salmonids were consistently higher in Meadow Creek which indicates that rearing habitat in this area may be much more desirable than conditions found in Fish Creek. Rainbow trout growth rates exceeded those determined for coho salmon in both areas.

Coho catch rates were highest in sluggish waters while rainbow catches were highest in swift waters. Salmonids preferred sand and/or gravel bottom types. Species composition in an area was more dependent on water velocities than on bottom types.

Preliminary surveys conducted in the Caswell Lake drainage indicate that this system has potential for coho enhancement.

Chinook salmon, O. tshawytscha (Walbaum), populations in Matanuska-Susitna Valley streams were the highest ever recorded for that region. In 1976 chinook escapement was near 20,000, which is 124% higher than the previous high escapement of 8,900 in 1973. Carcass data show that chinook age structures are very similar in east side Susitna River tributaries.

Coho data collected from streams located in the Matanuska-Susitna Valleys reveal that coho in those streams draining into Knik Arm average 59 cm (23 1/4 inches) in length and weigh 2.1 kg (4.7 lbs). Little Susitna River coho averaged 67 cm (26 1/2 Inches in length and weigh 3.6 kg (7.9 lbs).

BACKGROUND

There has long been a need to study rearing salmonid populations in the Matanuska-Susitna Valley streams. To date emphasis has been placed almost entirely on management of salmonid species through regulatory manipulation. Increased attention is now being directed toward artificial enhancement practices that are intended to increase salmonid populations. If salmon populations are to be enhanced through supplemental stocking it is vital that life history studies be initiated to provide guidelines that will insure maximum success of enhancement efforts. There is presently a scarcity of data that reveal what areas of various streams are utilized by rearing salmonids, carrying capacities of streams, migrational movements of rearing salmonid populations, and interactions between various salmonid species. Many streams undoubtedly would not benefit from enhancement projects unless some knowledge of the population dynamics of a particular stream is available. Although there is voluminous literature available on life histories of salmonid species, much of this information would not apply to streams in the Matanuska-Susitna Valleys due to the uniqueness of the drainage systems and the climatic conditions.

Funding has been a major deterrent to undertaking such studies in the past. An opportunity to begin a limited survey of the Big Lake watershed occurred in 1976 when the Youth Conservation Corp (YCC) was available to assist with the field work. A project was designed that would hopefully provide data to increase understanding of rearing salmonid populations in the Big Lake watershed with a minimum expenditure of funds. Minnow traps were the tool selected to conduct the study. It was hoped the project would provide guidelines for future studies of this nature. It was not known initially if minnow traps would be an effective sampling tool that would provide the type of information necessary to determine migrational movements, age and growth data, population densities, and species composition in various habitat types. The YCC was, however, available for work on this project only from June 21 to July 26.

The summer project was very successful and a substantial amount of informative data were collected. Minnow traps were extremely effective in capturing rearing fish species. Based on this success it was decided that the project would be continued during the winter months when time permitted. The majority of the winter sampling was conducted through the ice.

The Sport Fish Division is obligated to explore various drainage systems to determine where enhancement efforts might be beneficial in supplementing existing salmon populations and/or establishing new salmon populations. The Caswell Lake watershed is one system that has a depleted coho salmon population. A preliminary survey was conducted in the drainage to determine the feasibility of an enhancement program.

RECOMMENDATIONS

1. Continue the Meadow and Fish Creeks fisheries investigation.

   a. Minnow trapping should be conducted at more frequent intervals during an entire year and also include several of the lakes to determine the extent of lake rearing of coho salmon, Oncorhynchus kisutch (Walbaum), in the watershed.

   b. Determine by length frequency the age of salmonids in each trap before the fish are released.

   c. Conduct a detailed survey of Meadow and Fish creeks utilizing aerial photos to determine the approximate amount and locations of summer and winter rearing areas.

2. Collect additional data from the Caswell Lakes drainage to include a survey of Caswell Creek from the Parks Highway downstream to the Susitna River.

3. Determine chinook and coho salmon escapements in selected streams of the area.

OBJECTIVES

1. To determine and record the environmental characteristics of certain potential fishery waters of the job area and to develop and evaluate plans for the enhancement of resident fish stocks.

2. To assist as required in the investigation of public access status to the area's fishing waters and to make specific recommendations for selection of sites for segregation.

3. To make recommendations for the proper management of various sport fish waters in the area and to direct future studies.

TECHNIQUES

Minnow trapping was conducted on Fish and Meadow creeks utilizing wire and plastic 1/4-inch mesh minnow traps. Fish Creek was divided into three index areas and Meadow Creek was considered as a separate index area. A minimum of 10 numbered traps were fished daily in various types of stream habitat during the summer period. Each trap was fished at the same location for approximately 24 hours and was checked at one to three hour intervals during the day. At the end of the day each trap received fresh salmon eggs, and was left overnight. On each new sampling day all traps were moved to a new location in the index area and rebaited. Approximately five days were spent in each index area, depending on the number of traps being used.

Five salmonids were randomly selected from each trap daily, identified, measured and placed in a prepared solution of formaldehyde. Daily samples from all traps were placed in the same jar and labeled accordingly. The remaining fish in each trap were identified, counted, and released back into the stream.

A form was used to record all appropriate data for each trip (Figure 1). Fork lengths of fish samples were recorded to the nearest millimeter. Water depth was recorded in centimeters at each trap site and bottom types were noted on the form. The trap location in relationship to the stream channel was recorded as well as general current velocity which was visually categorized as either sluggish, moderate, moderately swift, or swift. After completion of each days trapping, total trap hours, total fish, and fish per trap hour were recorded at the bottom of the form.

Winter trapping followed the same procedures as during the summer except that in iced over areas traps could only be placed in areas where adequate water depth was present.

Scales were read from various sizes of salmonids to determine length ranges for each age class. Scales were pressed between glass slides and placed in the scale projector for examination.

Since the YCC was conducting the summer trapping, the daily samples were checked each week to determine the accuracy of the YCC species identification.

All salmonid stomachs were removed and the contents preserved in formaldehyde for future analysis. Stomach samples were separated by age class and index area.

Detailed volumetric surveys were conducted, using a recording fathometer and aerial photo techniques. A polar planimeter was used to compute the acre feet in each lake. A map measurer was used to determine shoreline distance.

Chinook spawning populations were enumerated by aerial, boat, and streambank surveys, while coho spawning populations were enumerated by foot

FISH - MEADOW CREEK INVENTORY

1. Index area __________ 2. Trap No. __________ 3. Date __________

4. Time Set __________ Time Set __________ Time Set __________

Time Lift __________ Time Lift __________ Time Lift __________

5. Water Temperature ____ °F 6. Water Depth __________ (cm)

7. Bottom Type ______________________________

8. Trap Location ______________________________

9. Current Velocity __________ 10. Weather __________

11. Preserved Sample 12. Released Sample

Species*	Length (mm)	Species	Numbers
______	__________	______	______
______	__________	______	______
______	__________	______	______
______	__________	______	______
______	__________	______	______

13. Total Trap Hours __________ 14. Total Fish __________

15. Fish per Hour __________

16. Additional Comments ______________________________

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* RB-rainbow, DV-Dolly Varden, SS-silver salmon, RS-red salmon, WF-whitefish, C-Cottid, SB-stickleback, SK-sucker.

Figure 1. Form Used During the Fish and Meadow Creeks Fisheries Investigation.

surveys within established index areas. Chinook and coho escapement counts were compared to previous years data. Chinook carcass data were collected and age classes were determined by length frequencies. Coho length-weight data were collected from sport caught coho and at the Fish Creek weir. Fork lengths were recorded to the nearest 0.1 centimeter and weight to the nearest 0.1 pound.

A temporary weir was located on Fish Creek immediately downstream from the Knik-Goose Bay Highway culvert. The weir was operated from July 10 to September 10 to enumerate all salmon species entering the Fish Creek system. The weir, constructed and maintained by the Commercial Fish Division, was described by Watsjold (1974).

Dissolved oxygen was determined by titration with phenylarsen oxide (PAO) and the use of powder pillows developed by Hach Chemical Company. Samples were collected at 3 m intervals to the maximum depth of the lake.

Monofilament gill nets (125' X 6') having five mesh sizes ranging from 0.5 to 2-inch bar measure, were used to collect fish specimens. Nets were normally set for 24 hours in each lake.

FINDINGS

Results

Fish and Meadow Creeks Fisheries Investigation:

The study in the Big Lake system was limited only to lotic environments, although there is a definite need to determine the extent of lake rearing that occurs in the watershed. The portion of the drainage where the study was initiated is shown in Figure 2.

Big Lake has a surface area of approximately 1,214 hectares (3,000 acres), a maximum depth of 26.8 meters (88 feet), and mean depth of 9.1 meters (30 feet). Meadow Creek is the primary inlet stream and drains numerous lakes located north and east of Big Lake. Fish Creek is the outlet stream of Big Lake and flows approximately 22.5 kilometers (14 miles) to Knik Arm.

Meadow Creek originates at Blodgett Lake and then flows through a chain of headwater lakes before emptying into Big Lake. There are numerous culverts and several bridges that cross the stream but none have any known effects on migrating fish. There are no velocity barriers on Meadow Creek which allows for free fish movement in the system. The bottom type varies from gravel and sand to detritus. Average width of the stream is approximately 6 meters (20 feet) and average depth is 76 centimeters (30 inches). Much of Meadow Creek flows through low swampy areas. In these areas the stream is typically .9 to 1.2 meters (3 to 4 feet) deep and slow moving, with a buildup of detritus on the stream bottom. Interspersed along its course are numerous gravel riffles that accomodate spawning salmonids.

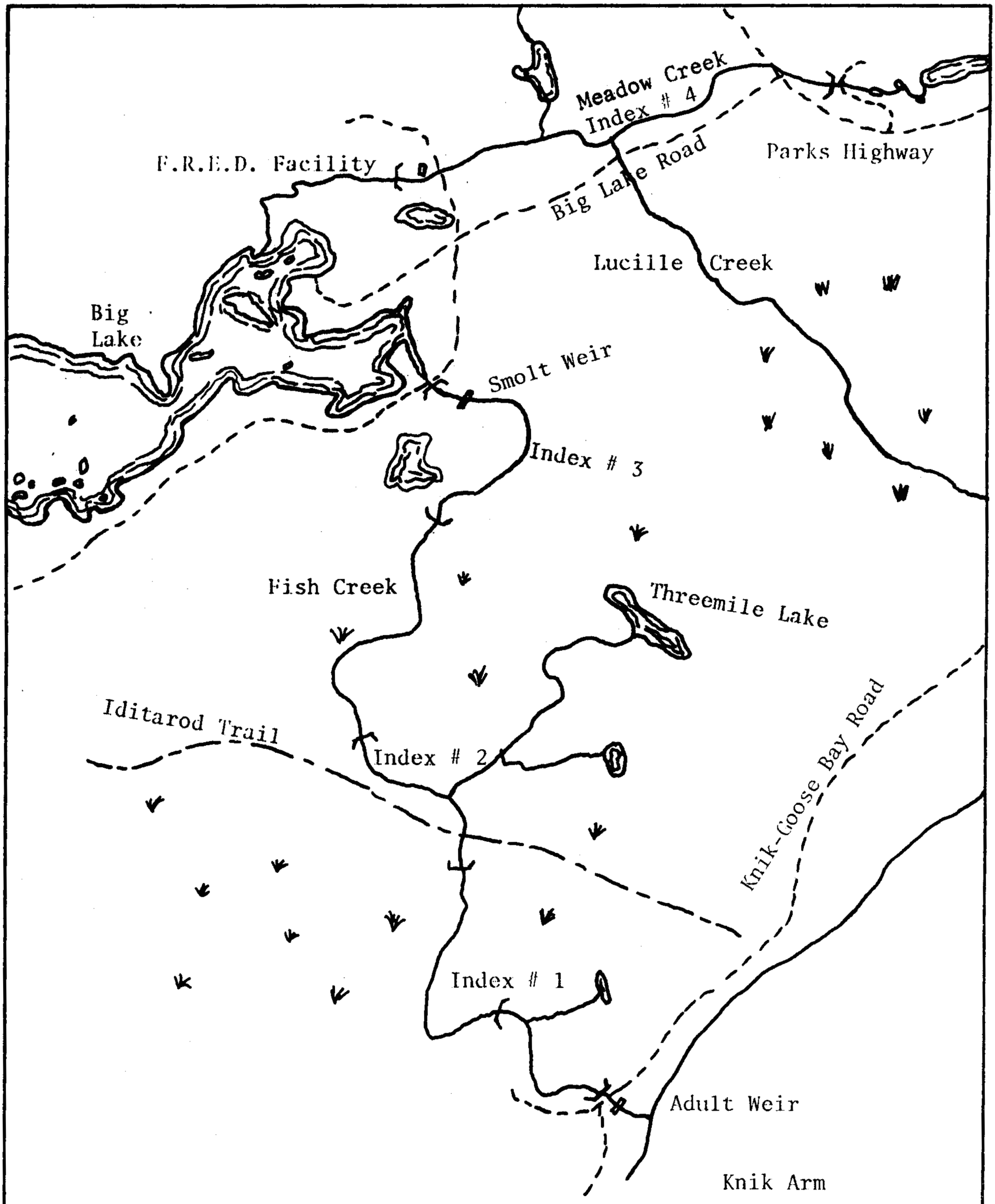

Figure 2. Big Lake Watershed Showing Locations of Index Areas on Fish and Meadow Creeks.

Stream flows have been taken intermittently at various locations along Meadow Creek by Department of Fish and Game personnel. At the headwaters near Blodgett Lake, flows fluctuate from 0.10 cms (3.67 cfs) to 1.14 cms (12.3 cfs). Flows recorded at the Parks Highway crossing during the June-October 1976 period varied from 0.12 cms (4.2 cfs) to 0.20 cms (7.2 cfs). Flows generally increase downstream due to several small inflowing tributaries. The pH fluctuates around 7.0 and temperatures during the winter months generally average 2.2° to 3.4°C (36° to 38.2°F) while summer temperatures average 15.5°C (60.0°F).

Fish Creek flows from Big Lake to Knik Arm and is fed by several tributary streams along its course. There is a water control structure located at the outlet of Big Lake which was installed in 1968 to maintain the water level in the lake. Fish Creek has a gentle to moderate gradient until the last two miles before flowing into Knik Arm where the gradient increases considerably. It has an average width of 10.6 meters (35 feet) and depth of 6.1 meters (20 inches). The streambed is mostly sand and gravel along its entire course.

Fish Creek flows fluctuate from .79 cms (28 cfs) to 3.17 cms (112 cfs) near the outlet of Big Lake. Flows recorded at the Knik-Goose Bay Road crossing during the June-October 1976 period varied from .48 cms (17 cfs) to 1.39 cms (49 cfs). The pH is 6.0 ppm and water temperatures during winter months generally average 1.2° to 2.6°C (34.1° to 36.7°F), which is slightly cooler than Meadow Creek. Summer temperatures average 15.5°C (60°F), which is identical to Meadow Creek.

Enumeration of adult salmon into the Big Lake watershed has been monitored by various methods since 1936 in Fish Creek. In 1969 a weir was installed by the Commercial Fish Division and a weir has been used annually since then to enumerate adult salmon runs. The Big Lake watershed produces primarily sockeye salmon, Oncorhynchus nerka (Walbaum), and a few coho salmon, O. kisutch (Walbaum). In past years the average sockeye escapement was approximately 80,000, with peaks up to 300,000. Past records show that runs up to 19,000 coho have been recorded, but these figures may not be reliable since escapement counts did not cover the entire period of coho migration, and it is unknown how the final counts were calculated. In recent years, salmon runs into the Big Lake watershed have declined drastically, reaching a low in 1973 when 2,705 sockeye and 210 coho were counted through the weir. Sockeye migration into Fish Creek generally starts about July 10 and peaks in the last week in July. Weir data collected since 1969 indicate that on an average, coho spawning migration reaches a high level during the August 5-18 period and then a week lapse in the run occurs with a second peak occurring during the August 26 to September 1 period.

The majority of the sockeye spawning occurs in Big Lake, Meadow Creek, and lakes at the headwaters of Meadow Creek. Sockeye also utilize the area of Fish Creek near the outlet of Big Lake. During low water years in the late 1960's over 40% of the sockeye escapement was observed spawning in Fish Creek.

Spawning coho utilize the entire Fish and Meadow Creek system. Spawning occurs as far downstream as the Knik-Goose Bay Road crossing on Fish Creek. Approximately 25% to 30% of the coho escapement generally spawns from the outlet of Big Lake downstream 2-1/2 miles. In 1976 surveys revealed that 63% of the total coho escapement spawned in Fish Creek. The remainder of the spawning coho utilized Meadow Creek. The majority of coho entering the Big Lake system are age 2.1 fish.

A smolt outmigration study was initiated in 1973 by the Commercial Fish Division. The smolt site was located on Fish Creek just downstream from the outlet of Big Lake. The smolt study has been continued every year since 1973 and enumerates all species migrating out of Big Lake into Fish Creek during the period of May 15 to July 1 when the weir is operational.

In 1975 construction began on an egg incubation facility located on Meadow Creek, which is designed to rebuild the salmon runs in the Big Lake watershed to former levels of abundance. It was completed in 1976 and is operated by the Fisheries Rehabilitation and Enhancement Division.

Summer minnow trapping in Fish and Meadow Creeks was conducted by the YCC stationed at a work camp located on Knik Lake. The major cause of concern was the problem of species identification during the trapping process since each week a new crew had to be trained. Proper species identification was imperative to insure the success of the project. Weekly examination of samples revealed that identification was not a major problem and less than a 3% error occurred even though the fish ranged from 30 to 100 mm in length.

The index areas established on Fish and Meadow Creeks are shown in Figure 2. Minnow traps were fished a total of 4,055 hours in the four index areas during the period June 21 to July 28. Results of the trapping are shown in Table 1. The primary species captured were coho salmon, rainbow trout, _Salmo gairdneri_ Richardson, threespine stickleback, _Gasterosteus aculeatus_ (Linnaeus), ninespine stickleback, _Pungitius pungitius_ (Linnaeus), and unidentified cottid and lamprey species. Although an attempt was made to spend an equivalent amount of time trapping in each index area, this was not always possible due to the work schedule of the YCC program. A total of 608 trapping hours were conducted in Index #3 which is somewhat lower than what occurred in the other three index areas.

Since the summer portion of the project proved successful, it was decided to continue the project into the winter months. Permanent biologists conducted all winter sampling. Minnow traps were fished a total of 4,164 hours during the period of October 27 to December 20. The results of this trapping are included in Table 1 along with the summer data. An attempt was made to duplicate the summer work and to equal the number of trap hours obtained during the summer period. This goal was not reached in Index #1 where extremely poor conditions persisted with severe glacial overflow present in most of the index area.

Table 1. Catch By Index Area and Species* in Fish and Meadow Creeks, Summer and Winter, 1976.

Index Area	Time Period	No. Traps	Total Trap Hr.	No. SS	Catch/ Trap Hr.	No. RT	Catch/ Trap Hr.	No. SB	Catch/ Trap Hr.	No. C	Catch/ Trap Hr.
1	6/21-6/25 7/27-7/28	70	1,325	308	0.23	225	0.17	344	0.26	71	0.05
2	6/28-7/1 7/14-7/15	60	969	185	0.19	302	0.31	626	0.65	24	0.02
3	7/6-7/13	50	608	936	1.54	743	1.22	2,984	4.91	21	0.03
4	7/19-7/26	50	1,153	340	0.29	337	0.29	1,241	1.08	508	0.44
Total		230	4,055	1,769	0.44	1,607	0.40	5,195	1.28	624	0.15
1	10/27-10/28 12/20	28	654	337	0.52	297	0.45	9	0.01	6	0.01
2	11/2-11/4	41	958	475	0.50	880	0.92	62	0.06	33	0.03
3	11/8-11/9 11/22	48	1,070	2,828	2.64	1,027	0.96	178	0.17	9	0.01
4	11/15-11/17 11/29	64	1,482	912	0.62	499	0.34	238	0.16	29	0.02
Total		181	4,164	4,552	1.09	2,703	0.65	487	0.12	77	0.02

* Key: SS = coho salmon; RT = rainbow trout; SB = stickleback; C = cottids.

Summer trapping results shown in Table 1 reveal that the catch of all species was the highest in Index #3 and far exceeded the catch rates in the other index areas. Index #3 had the highest coho catch rate, followed in declining order by Index #4, #1, and #2. Index #3 also had the highest rainbow catch rate, followed by Index #2, #4, and #1. Sticklebacks were the most abundant species found in Index #3.

Trapping during the winter months yielded considerably higher salmonid catch rates in all areas except Index #4 than were recorded during the summer. Catch rates for rainbow trout increased only slightly during the winter in Index #4. Catch rates for species other than salmonids were almost negligible.

Winter coho catch rates followed the same trend as during the summer with the highest density again occurring in Index #3, with lesser numbers in Index #4, #1, and #2. The notable difference between summer and winter catch rates involves rainbow trout. Winter rainbow catch rates declined in Index #3 and were almost identical to those catches obtained in Index #2. Rainbow catch rates in Index #1 also increased dramatically, while the catch rate in Index #4 remained nearly identical to the summer catch rate. Summer and winter salmonid catch rates are graphically depicted in Figure 3.

Salmonid species composition within each index area during summer and winter months is shown in Table 2. During the summer period coho populations were somewhat higher than rainbow populations in Index #1 and #3, and the two species were equally represented in Index #4. Rainbow were present in much higher numbers than coho in Index #2. Winter species composition was almost identical to the summer period in both Index #1 and #2. A considerable difference occurred in Index #3 and #4 where coho were much more abundant during the winter than during the summer. This change in composition would be expected since rainbow catch rates in Index #3 declined considerably during the winter and coho catch rates increased in Index #4.

Salmonid catch rates by percent in each index area for summer and winter are shown in Table 3. These data show the percent of salmonids residing in the four index areas. During the summer 68.4% of the coho were trapped in Index #3 while 8.5% to 12.9% were captured in each of the other three index areas. During the winter 61.7% of the coho were in Index #3 and 11.7% to 14.5% were in the other index areas. During the summer 61.3% of the rainbow were captured in Index #3 while 8.5% to 15.6% were trapped in the other three index areas. Winter sampling revealed that only 36% of the rainbow were captured in Index #3 and 34.5% were trapped in Index #2. The only area that showed little change was in Index #4 where 12.7% of the rainbow were caught. These data suggest that the rainbow distribution shifted in Fish Creek between the summer and winter sampling periods.

Age and growth data by index area were determined for salmonid samples. Tables 4 and 5 show average lengths by age group in each index area. Age 0+ coho averaged 37.3 mm in length at the beginning of summer sampling in Index #1. One month later age 0+ coho averaged 51.6 mm in length in

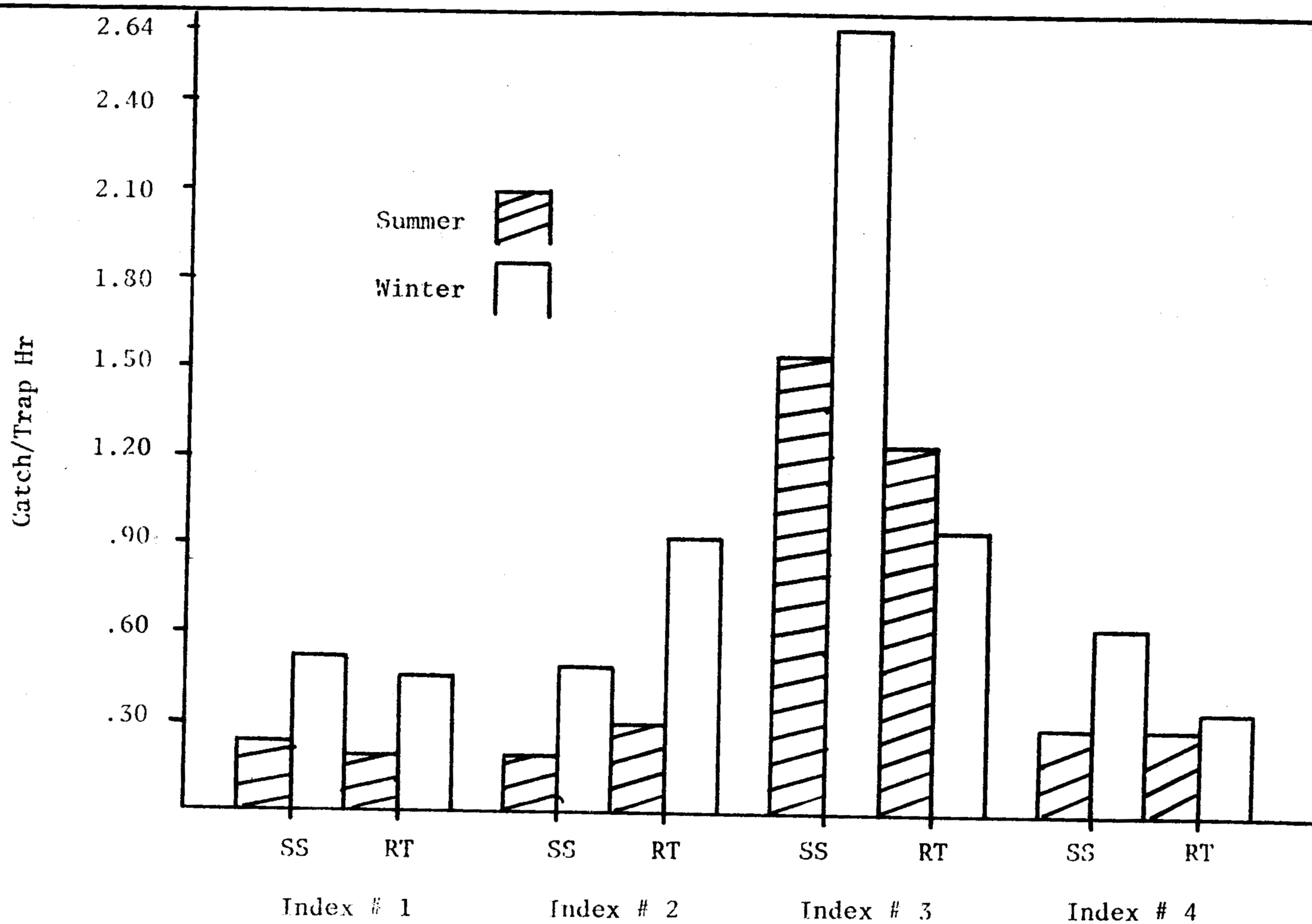

Figure 3. Catch Rate by Index Area and Species in Meadow and Fish Creeks, Summer and Winter, 1976.

Table 2. Species* Composition of Salmonids Within Each Index Area During Summer and Winter Sampling Periods.

Index 1			Index 2			Index 3			Index 4		
Species	No.	%	Species	No.	%	Species	No.	%	Species	No.	%
Summer Sample											
SS	308	57.8	SS	185	38.0	SS	936	55.7	SS	340	50.2
RT	225	42.2	RT	302	62.0	RT	743	44.3	RT	337	49.8
Total	533			487			1,679			677	
Winter Sample											
SS	337	53.2	SS	475	35.0	SS	2,828	73.4	SS	912	64.6
RT	297	46.8	RT	880	65.0	RT	1,027	26.6	RT	499	35.4
Total	634			1,355			3,855			1,411	

* Key: SS = coho salmon; RT = rainbow trout.

Table 3. Salmonid Catch Rates by Index Area for Summer and Winter Sampling Periods.

Summer Sample					Winter Sample				
Index	Catch/Trap Hr.				Index	Catch/Trap Hr.			
Area	Coho	%	Rainbow Trout	%	Area	Coho	%	Rainbow Trout	%
1	0.23	10.2	0.17	8.5	1	0.52	12.1	0.45	16.8
2	0.19	8.5	0.31	15.6	2	0.50	11.7	0.92	34.5
3	1.54	68.4	1.22	61.3	3	2.64	61.7	0.96	36.0
4	0.29	12.9	0.29	14.6	4	0.62	14.5	0.34	12.7

Table 4. Age and Average Lengths* of Coho Salmon and Rainbow Trout Captured in Each Index Area During the Summer Sampling Period.

Summer Period									
Coho Salmon					Rainbow Trout				
Age	n	$\bar{x}$	$\pm$ SD	%	Age	n	$\bar{x}$	$\pm$ SD	%
				Index # 1	6/21-6/25				
0+	35	37.3	5.29	57.4	I+	59	75.1	9.17	84.3
I+	26	82.4	3.73	42.6	II+	11	126.2	11.04	15.7
				Index # 2	6/28-7/1, 7/14-7/15				
0+	62	42.0	5.46	63.3	I+	91	74.9	11.82	82.0
I+	35	81.2	6.77	35.7	II+	20	122.2	9.77	18.0
II+	1	128.0		1.0					
				Index # 3	7/6-7/13				
0+	76	48.5	4.70	67.3	I+	120	72.9	10.65	88.9
I+	37	81.4	8.05	32.7	II+	15	127.5	7.27	11.1
				Index # 4	7/19-7/26				
0+	51	58.2	5.56	50.0	I+	103	84.7	10.53	96.3
I+	51	91.6	6.29	50.0	II+	4	116.3	4.19	3.7
				Index # 1	7/27-7/28				
0+	49	51.6	8.09	89.1	0+	1	41.0		2.6
I+	6	80.2	7.25	10.9	I+	38	85.3	10.19	97.4

* Lengths recorded in millimeters.

Table 5. Age and Average Lengths* of Coho Salmon and Rainbow Trout Captured in Each Index Area During the Winter Sampling Period.

Winter Period									
Coho Salmon					Rainbow Trout				
Age	n	$\bar{x}$	$\pm$ SD	%	Age	n	$\bar{x}$	$\pm$ SD	%
Index # 1									
0+	22	52.5	6.47	51.2	0+	6	45.5	7.06	9.5
I+	21	89.1	9.30	48.8	I+	54	89.4	9.77	85.7
					II+	3	121.7	9.07	4.8
Index # 2									
0+	37	53.8	8.60	56.1	0+	3	54.3	9.60	2.5
I+	29	89.0	9.10	43.9	I+	111	80.9	11.07	91.7
					II+	7	125.6	6.85	5.8
Index # 3									
0+	128	59.9	7.46	84.8	0+	4	50.8	3.20	5.8
I+	23	85.5	9.08	15.2	I+	80	84.8	13.36	95.2
Index # 4									
0+	23	67.8	6.02	20.2	0+	80	57.6	8.64	56.3
I+	75	91.2	12.42	65.8	I+	62	88.4	9.72	43.7
II+	16	113.9	8.74	14.0					

* Lengths recorded in millimeters.

Index #1. The winter sample showed that very little additional growth had occurred in Index #1 as age 0+ coho averaged 52.5 mm in length. Because of time limitations Index #1 was the only area that was sampled a second time during the summer, therefore growth can only be compared between summer and winter in the other three index areas. Age 0+ coho in Index #2 averaged 42.0 mm in length during the summer and by winter these coho averaged 53.8 mm. Age 0+ coho in Index #3 were 48.5 mm in length during the summer and had increased to 59.9 mm by winter. In Index #4 age 0+ coho were much larger than in the other index areas, averaging 58.2 mm during the summer and increasing to 67.8 mm by winter. Age 0+ coho under 30 mm in length are not effectively captured by minnow traps, therefore the earlier samples may have been somewhat biased.

Average lengths of age 1+ coho showed little size difference in Index #1-#3 during the summer period. Average lengths varied from 81.2 to 82.4 mm in Fish Creek. Age 1+ coho in Index #4 averaged 91.6 mm in length. Winter sampling revealed that age 1+ coho grew very slowly and average lengths varied from 85.5 to 89.1 mm in Index #1-3.

Rainbow trout samples were dominated by age 1+ individuals during the summer and winter periods. Age 0+ rainbow were too small to be effectively captured during the summer. Like the coho, age 1+ rainbow lengths varied only slightly during the summer period from 72.9 to 75.1 mm in Index #1-3. Age 1+ rainbow in Index #4 averaged 84.7 mm in length which follows the same trend as coho. Age 1+ rainbow had reached a length of 85.3 mm in Index #1 when this area was resampled during the summer. Very few age 0+ rainbow were captured in Index #1-3 during the winter period, although they had reached a catchable size. The majority of age 0+ rainbow were captured in Index #4 and these had reached a size of 57.6 mm. Unlike the coho, age 1+ rainbow grew rapidly during the fall period and by winter they had gained 4 to 12 mm in length over their summer lengths.

Table 6 depicts the average lengths of salmonids captured in all index areas during the summer and winter sampling periods. These data show that age 0+ coho grew an average of 10.9 mm between the sampling periods. Age 1+ coho grew an average of only 4.8 mm in length while age 1+ rainbow gained 12.1 mm in length. Sample sizes of other age groups are insufficient to make comparisons.

Length frequencies of coho and rainbow by age class are shown in Figures 4 and 5. During the summer period there is very little overlap in lengths of age 0+ and age 1+ coho and rainbow. During the winter period overlap increased for both species.

Water velocities at each trap location were visually determined by the YCC crew and recorded as sluggish, moderate, moderately swift, and swift. Table 7 shows the relationship between the rate of capture of various species and current velocity.

Table 6. Age and Average Lengths* of Coho Salmon and Rainbow Trout Captured in All Index Areas During the Summer and Winter Sampling Periods.

Coho Salmon					Rainbow Trout				
Age	n	$\bar{x}$	$\pm$ SD	%	Age	n	$\bar{x}$	$\pm$ SD	%
Summer Period									
0+	273	48.0	8.87	63.7	0+	1	41.0		0.2
I+	155	84.8	8.05	36.1	I+	411	72.8	11.89	89.0
II+	1	128.0		0.2	II+	50	124.2	9.45	10.8
Winter Period									
0+	210	58.9	11.50	56.1	0+	93	56.4	8.92	22.7
I+	148	89.6	11.03	39.6	I+	307	84.9	11.72	74.9
II+	16	113.9	8.74	4.3	II+	10	124.4	7.29	2.4

* Lengths recorded in millimeters.

Table 7. Relationship of Catch Rates by Species* to Water Velocities in Fish and Meadow Creeks.

Water Velocity**	Catch/hr SS	RT	SB	C
Sluggish	0.60	0.29	2.33	0.20
Moderate	0.45	0.38	0.53	0.41
Moderately Swift	0.31	0.44	0.78	0.06
Swift	0.23	0.59	0.19	0.07

* SS = coho salmon; RT = rainbow trout; SB = stickleback; C = cottids.
** Water velocities were visually determined at each trap site.

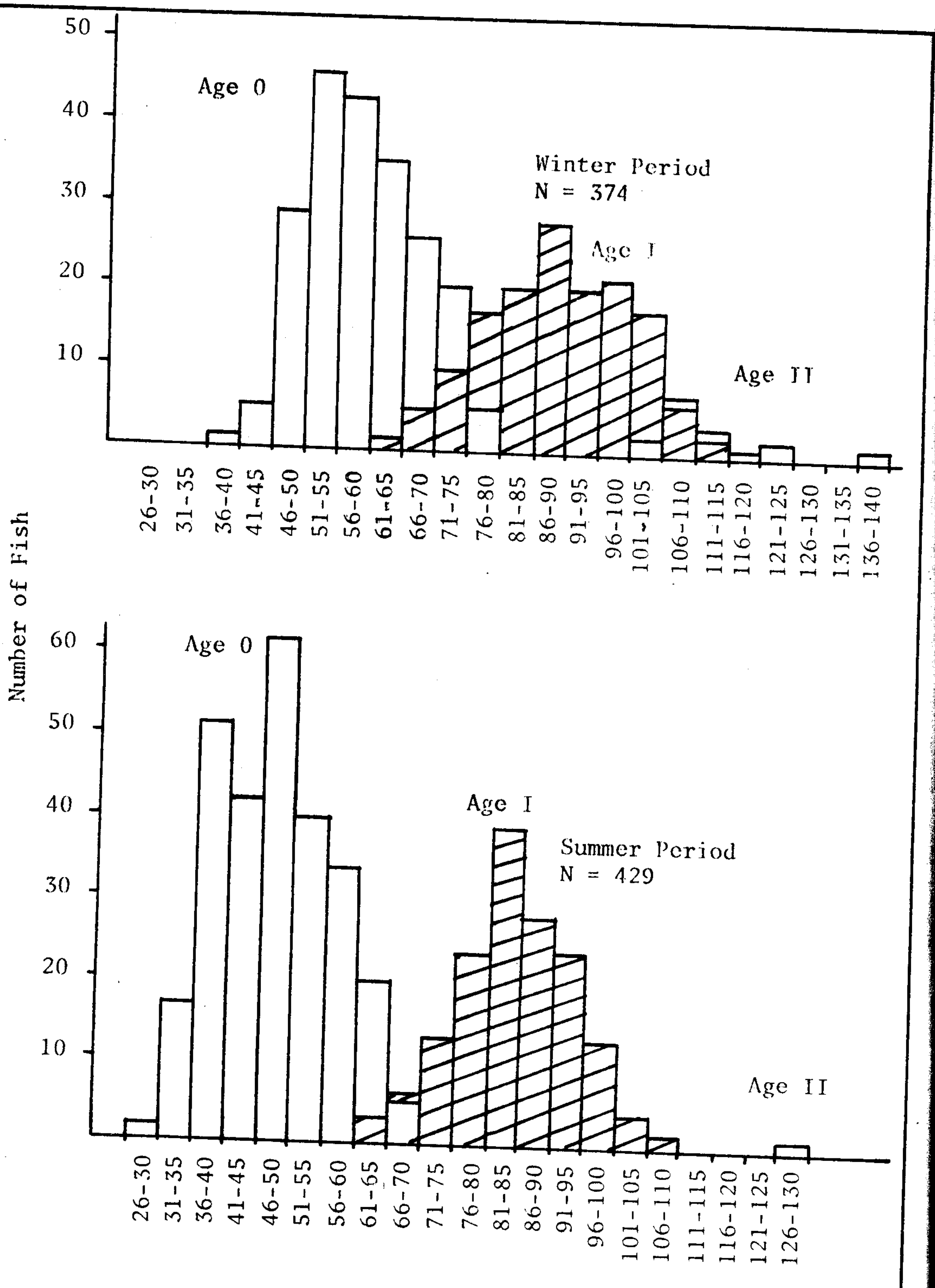

Figure 4. Length Frequency Histogram for Age Groups of Coho Salmon Captured During Summer and Winter Sampling in Fish and Meadow Creeks, 1976.

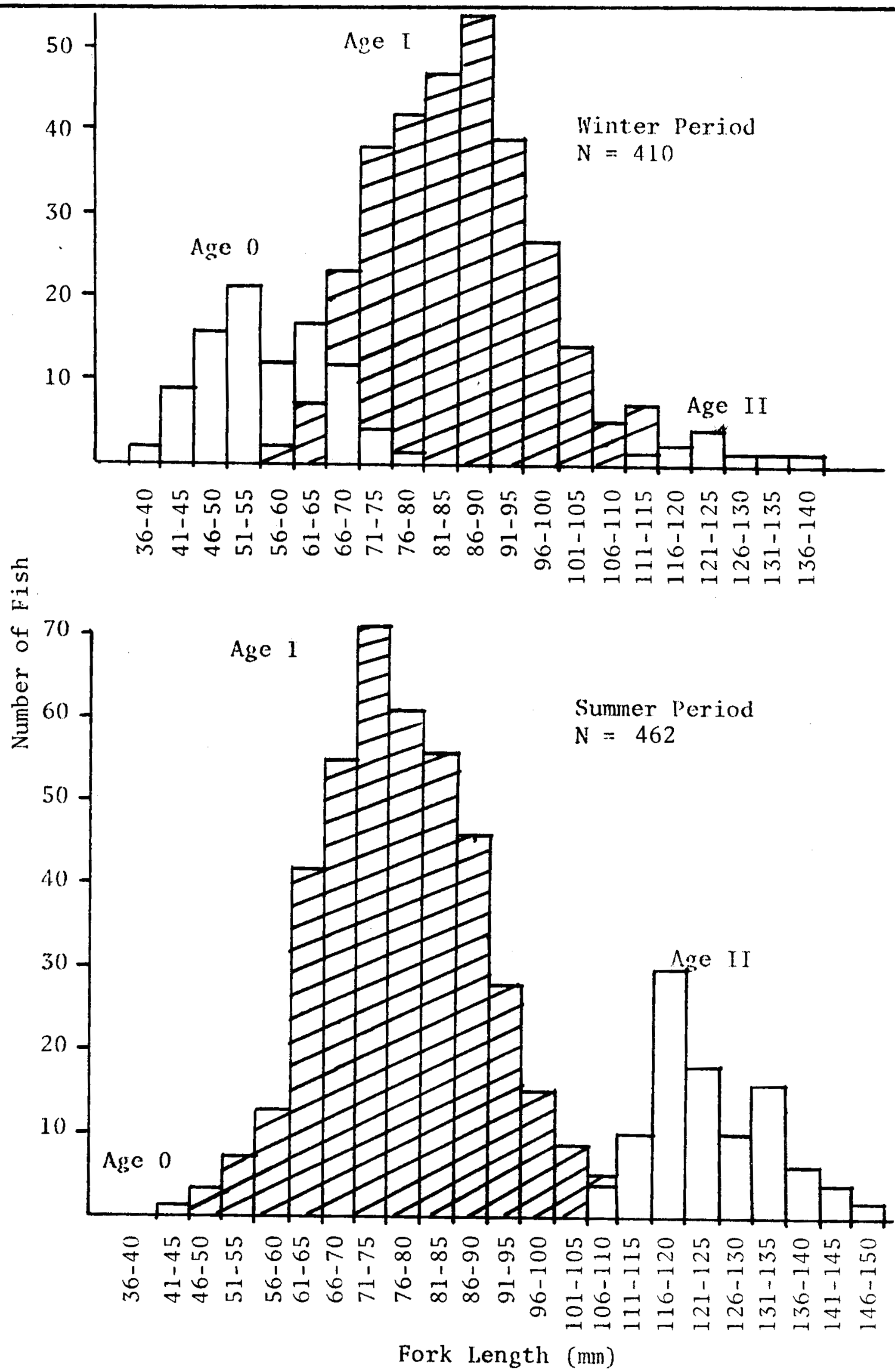

Figure 5. Length Frequency Histogram for Age Groups of Rainbow Trout Captured During Summer and Winter Sampling in Fish and Meadow Creeks, 1976.

Caswell Lakes Survey:

A preliminary survey of five lakes was conducted during the 1976 summer season in the Caswell Lake area which is reached via an access road originating at Mile 88 Parks Highway. The Caswell Lake drainage contains a remnant coho salmon run. The purpose of the survey was to obtain information on the present condition of the salmonid populations utilizing the drainage and to determine whether a salmon enhancement program would be beneficial.

Caswell Lake is the largest lake in the drainage totaling 110.5 surface acres with a maximum depth of 27 feet. The lake is drained by Caswell Creek, which is a tributary of the Susitna River. There are four lakes just south of Caswell Lake which range from 14 to 33 surface acres with maximum depths of 6.7 to 10 meters (22 to 33 feet). Since these lakes have not been named they will be referred to by numbers, including Caswell Lake. The relationship of these lakes to each other in the drainage is shown in Figure 6. Morphometric data for the five lakes are presented in Table 8. Caswell Lakes #1-4 have well defined inlets and outlets, while Caswell Lake #5 appears to be landlocked, fed only by water seepage from surrounding marsh areas. Subdivision roads cross the outlets of Caswell Lake #2 and #3. Culverts placed at these crossings do not allow for upstream movement of fish due to the elevated nature of their installation. The culverts were installed in 1968 and were placed in a manner that would raise the water level in the two lakes. Caswell Lakes #2, #3, and #4 form one of the main tributaries of Caswell Creek and would be useful rearing areas if salmonids were able to migrate upstream into these lakes.

The terrain around the lakes is mostly flat and marshy, with black spruce being the dominate forest type, although birch is found on elevated areas. Water chemistry collected from Caswell Lake #1 revealed a pH of 7.0, total hardness of 17 ppm, total alkalinity of 34 ppm, and conductivity of 44 micromhos/cm. This sample is probably representative of all the waters in the drainage and indicates a low level of productivity exists in the drainage. Surface water temperatures taken on August 25 ranged from 16°-18°C (62°-64°F). Plankton tows conducted on August 31 revealed that rotifers, Aspalancha sp., were dominant, with lesser numbers of Bosmia coregoni and Cyclops scutifer. A benthic sample collected only one snail, Gyrallus and one clam, Pisidium.

Variable mesh gill nets were set in all five lakes. The results of gillnetting are shown in Table 9. Threespine sticklebacks were present in all five lakes. Coho salmon were captured only in Caswell Lake #1. Although the coho catch was 0.33 fish/hour this would not be indicative of their abundance since they are not of sufficient size to be captured efficiently by gill nets. Rainbow trout were present in good numbers in Caswell Lake #1. The dominant species as measured by gill net in all lakes except Caswell Lake #5 was the longnose sucker, Catostomus catostomus (Forster). Caswell Lake #5 gill net results indicate no fish species are present as expected, since the lake is landlocked. It appears the rainbow population in Caswell Lake #2 and #3 is very small, possibly due to the improper culvert installations which do not allow

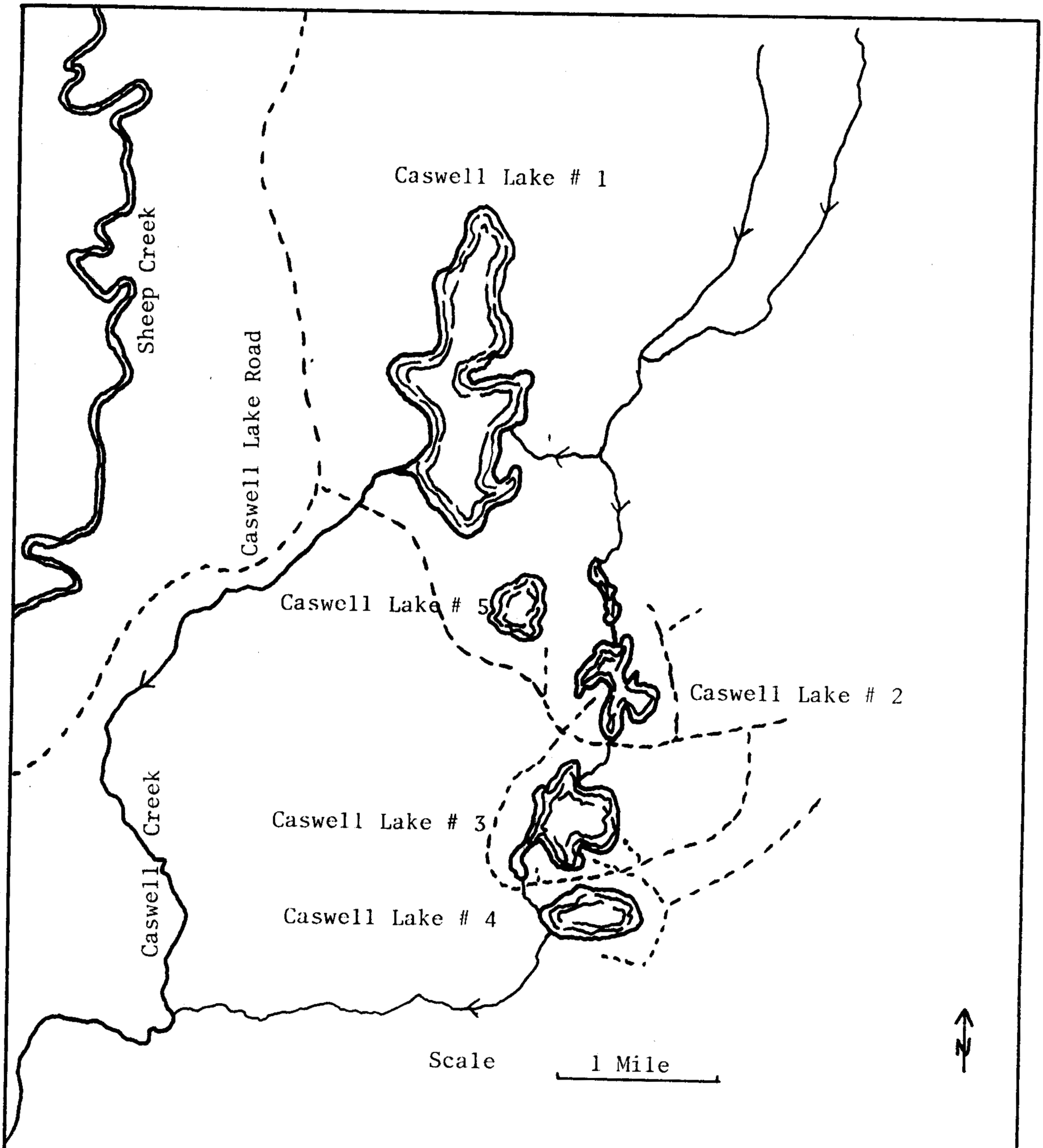

Figure 6. Caswell Lakes Area Showing Drainage Patterns Connecting the Surveyed Lakes, 1976.

Table 8. Morphometric Data for Caswell Lakes.

Lake	Surface Area Ha	Surface Area Acres	Maximum Depth M	Maximum Depth Ft	Mean* Depth M	Mean* Depth Ft	Volume m^3	Volume Acre-ft	Shoreline Distance Kilometers	Shore** Development	Littoral*** Area (%)	Elevation M	Elevation Ft	Location
Caswell #1	44.7	110.5	8.2	27	4	13.1	1,759,998	1,443	4.562	1.92	54	91	300	T22N R4W Sec 2,3, 10,11
Caswell #2	8.7	21.5	7.3	24	1.7	5.7	150,020	123	2.425	2.31	88	91	300	T22N R4W Sec 11
Caswell #3	13.4	33.1	10.1	33	4.6	15.1	608,620	499	2.216	1.70	48	91	300	T22N R4W Sec 14
Caswell #4	7.6	18.7	6.7	22	3.9	12.8	291,503	239	1.157	1.18	64	91	300	T22N R4W Sec 14
Caswell #5	5.7	14.2	9.8	32	5.8	18.9	328,093	269	1.019	1.19	34	91	300	T22N R4W Sec 14

* Mean depth is volume divided by surface area.
** Shore development is the ratio of the length of shoreline to circumference of a circle having the same area as the lake.
*** Littoral area is that portion of the lake less than 15 feet in depth.

Table 9. Species* Composition in Caswell Lakes as Determined by Gill Nets, 1976.

Lake	Species	Number	Length (mm) Range	Mean	Catch/Net Hour
Caswell # 1	RT	40	108-381	198	0.61
	SS	22	98-124	108	0.33
	LNS	56	115-420	292	0.85
	WF	1	405	405	0.02
Caswell # 2	RT	6	200-285	240	0.31
	LNS	23	160-290	212	1.18
Caswell # 3	RT	2	180-230	205	0.11
	LNS	23	105-370	183	1.24
Caswell # 4	LNS	31	105-425	249	1.68
	WF	3	245-320	278	0.16
Caswell # 5	No Catch				

* Key: RT = rainbow trout; SS = coho salmon; LNS = Longnose sucker; WF = whitefish.

rainbow and coho to move freely in this part of the drainage. No small coho were captured in either of the lakes. No coho or rainbow were captured in Caswell Lake #4 which indicates that there may be a blockage in the outlet stream that prohibits young salmonids from migrating upstream from Caswell Creek.

Minnow trapping was conducted in all but Caswell Lake #5. Minnow traps were placed near inlet and outlet streams. Minnow traps captured rainbow trout, coho salmon, and threespine sticklebacks. Rainbow and coho were caught only in Caswell Lake #1, which again indicates the absence of young salmonids in Caswell Lake #2, #3, and #4. A total of 206 coho and 41 rainbow were captured overnight in minnow traps set at the inlet and outlet streams of Caswell Lake #1. Of the coho, 36% were age 0+ and averaged 65 ± 5.4 mm in length and 64% were age 1+ and averaged 94 ± 10.6 mm.

In September a float trip was made down Caswell Creek from a point just below the outlet of Caswell Lake #1 to the Parks Highway. A fairly large beaver population inhabits the drainage area, as witnessed by the large number of dams encountered during the survey. Many of the dams were not maintained and presented no problem for migrating adult coho as the stream flowed underneath them. Several adult coho were observed trapped among the dams which indicates that many of the dams are impeding upstream migration. Despite the many dams across the stream, 35 adult coho were observed from the lake outlet downstream to the Parks Highway. The beaver dams are creating a large amount of rearing area for young salmonids but at the same time they have destroyed an unknown amount of spawning area. It appears that spawning area is limited in the entire drainage. There may have been extensive spawning areas in Caswell Creek in the past but these would have been covered over due to extensive numbers of beaver dams on the stream.

Annual maximum stream flows in Caswell Creek during the period of 1963-1972 ranged from a low of 0.96 cms (34 cfs) during the dry year of 1970 to a high of 5.86 cms (207 cfs) in 1965. Average maximum flow for this period is 3.09 cms (109 cfs).

Dissolved Oxygen Sampling:

Each winter dissolved oxygen sampling is conducted in various stocked lakes which have histories of low winter O_2 levels or in lakes being considered for future management. A total of 14 lakes were checked during the 1975-76 winter, and six of these lakes were sampled at various periods between January and April to follow the decline of dissolved oxygen during late winter months (Table 10). Lucille, Canoe, Seymour, Memory, Meirs, Johnson, and Matanuska Lakes had surface O_2 levels ranging from 0.0 to 2.2 ppm during the 1974-75 winters (Watsjold, 1975).

The 1975-76 winter sampling revealed Lucille Lake surface O_2 levels did not go lower than 4.7 ppm which is the highest level recorded during the last several years. Normal O_2 levels were recorded in Matanuska, Meirs, and Johnson lakes. Canoe, Seymour, and Memory Lakes experienced surface O_2 levels from 0.3 to 0.8 ppm which was the same or lower than the

Table 10. Lakes Tested for Dissolved Oxygen*, Matanuska-Susitna Valleys, 1976.

Depth (m)	Seymour				Visnaw				Lalen			
	1/21	2/20	3/19	4/9	1/21	2/20	3/19	4/9	1/21	2/20	3/19	4/9
1	3.0	2.3	1.4	0.8	12.3	11.4	9.9	9.1	12.1	11.1	8.7	7.6
3	1.7	1.2	1.0	0.3	9.0	6.3	5.8	4.6	7.6	4.8	3.7	3.1
5		0.1	0.4	0.2	7.7	5.2	3.2	1.4	4.2	1.8	0.7	1.2
Ice (cm)	85.0	93.0	93.0	96.0	83.0	89.0	94.0	99.0	85.0	91.0	97.0	96.0
Snow (cm)	10.0	15.0	33.0	10.0	12.0	20.0	45.0	21.0	12.0	20.0	46.0	20.0

Depth (m)	Lucille				Canoe				Memory		
	1/21	2/19	3/16	4/7	1/30	2/19	3/16	4/7	2/19	3/16	4/7
1	4.7	5.3	5.7	5.6	1.6	0.8	1.9	4.7	1.5	0.3	0.7
3	3.2	2.5	3.0	4.7	1.6	0.6	0.3	3.2	0.4	0.3	0.4
5		0.5	1.0	2.7	1.1	0.4	0.2	0.6	0.0	0.1	0.1
Ice (cm)	86.0	108.0	107.0	103.0		102.0	108.0	110.0	104.0	107.0	107.0
Snow (cm)	0.0	0.0	10.0	0.0		1.0	15.0	0.0	7.0	20.0	0.0

Table 10. (Con't.) Lakes Tested for Dissolved Oxygen*, Matanuska-Susitna Valleys, 1976.

Depth (m)	Matanuska 3/10	Meirs 3/12	Little No Luck 3/9	Big No Luck 3/9	Johnson 3/12	Junction 3/11	Victor 3/11	Harriet 3/11
1	5.9	4.3	10.5	11.6	4.5	4.2	10.2	6.9
3	5.9	3.6	10.3	11.1	2.6	3.7	9.8	6.7
6	5.5	3.6	7.9	8.4	0.7	2.1	2.8	3.0
9	3.3	3.6	4.9	6.8	0.4	0.4	0.6	0.6
12	2.7	2.6	3.8	7.0	0.2			
15	1.5	1.3						
18	0.7	0.4						
21	0.5							
Ice (cm	98.0	94.0	96.0	96.0	109.0	104.0	107.0	108.8
Snow (cm)	0.0	0.0	81.0	81.0	0.0	0.0	0.0	0.0

* All measurements are in ppm.

preceding winter levels. We were unable to determine the cause of the variations that occurred in these lakes during the 1975-76 winter period.

Lake Stocking Evaluations:

Sampling of stocked lakes is conducted to evaluate and develop present stocking practices aimed at enhancing resident fish stocks.

In 1976, 11 stocked lakes were sampled under ice with variable mesh gillnets. Nine of these lakes contained coho salmon which are being stocked at an increasing rate because of their ability to survive at a much higher rate than rainbows in low productivity waters. Since the advent of the various Alaskan strains, many of the rainbow plants are now being evaluated under a project which is designed to provide guidelines for stocking programs.

Gill net catch data and stocking histories are presented in Table 11. On May 28, 1976 four lakes were stocked with coho weighing 341/lb. and on June 1 an additional four lakes were stocked with coho weighing 298/lb. Mean lengths of age 0+ coho after six months of residency in the eight planted lakes ranged from 108 mm in Benka Lake to 154 mm in Memory Lake. Direct comparisons in growth rates cannot be made in most instances due to sample sizes and/or small size of fish that are not fully susceptible to gill netting. It is apparent that the reinfestation of threespine sticklebacks has reduced growth rates in Lucille Lake. Age 0+ coho normally attain a mean length of 150-160 mm after six months residency but the 1976 sample averaged only 125 mm. Memory Lake age 0+ coho attained the largest size of any of the eight stocked coho lakes, although it is a low productivity lake. This is probably due to two successive winters when dissolved oxygen levels were as low as 0.3 ppm and the rainbow trout population was virtually annihilated leaving the lake fallow for 1 1/2 years which allowed for a build-up of food organisms.

Age 1+ coho were present in four lakes and their average lengths ranged from 177 mm in length in Loon Lake to 306 mm in Lucille Lake.

Chinook Studies:

The 1976 chinook salmon, O. tshawytscha (Walbaum), escapement surveys on east side Susitna River tributaries, and tributaries of the Talkeetna and Chulitna rivers were conducted from July 15 to August 3. Spawning activity commenced a week earlier than normal in all surveyed streams. Stream flows were much lower than normal due to low rainfall. A total of 16,753 chinook were actually observed during escapement surveys. Watsjold (1974) found that during aerial surveys chinook were observed in alpine streams with 70% efficiency and chinook were observed in streams flowing through heavily forested areas with 55% efficiency. Based on these findings, as well as food counts (approximately 100% efficiency) it was estimated that the 1976 chinook escapement was 19,900 which is 124% higher than the previous high escapement of 8,900 chinook in 1973 (Table 12).

Table 11. Gill Net Results and Stocking Histories of Managed Lakes, Matanuska-Susitna Valleys, 1976.

Lake	Date Sampled	Species*	Age Class	n	Length (mm) $\bar{x}$	$\pm$ SD	Range	Catch/ Net Hr.	Date Stocked	Total Number	Per Gram	Per Hectare
Benka	12/15/76	SS	0+	3	108	2.64	105-110	0.04	5/28/76	23,000	751	462
		SS	II+	14	237	25.56	198-286	0.20	7/19/74	7,811	321	158
		DV		8	223	37.05	180-292	0.11	Wild			
Christiansen	12/15/76	SS	0+	15	124	13.46	113-159	0.21	5/28/76	26,900	751	371
Finger	12/22/76	SS	0+	27	137	18.08	113-173	0.69	5/28/76	72,500	751	494
		SS	I+	53	290	30.15	205-375	1.36	6/18/75	72,500	1,078	494
		SS	II+	1	422		422	0.03	7/9/74	108,600	2,037	741
Loon	12/17/76	SS	I+	8	177	10.10	165-198	0.19	7/22/75	10,800	646	247
		SS	III+	32	239	17.85	212-283	0.74	8/8/73	32,405	309	741
Lucille	12/22/76	SS	0+	16	125	13.58	115-160	0.36	5/28/76	72,500	751	494
		SS	I+	19	306	18.58	272-337	0.43	6/18/75	72,500	1,078	494
		SS	III+	3	313	43.50	270-357	0.06	7/2/73	55,500	1,157	371
Memory	12/9/76	SS	0+	52	154	12.75	125-190	1.27	6/1/76	16,600	657	494
Prator	12/17/76	SS	0+	2	114	1.41	113-115	0.04	6/1/76	9,800	657	247
			III+	3	331	24.51	306-355	0.04	8/10/73	15,000	359	378
Rocky	12/17/76	SS	0+	36	129	11.43	113-166	0.78	6/1/76	11,800	657	494
		RT	II+	5	374	18.47	350-390	0.10	6/24/74	33,000	2,149	1,384
Victor	12/7/76	SS	0+	11	146	8.62	128-159	0.26	6/1/76	2,800	657	511
		SS	I+	23	257	20.59	214-283	0.55	6/17/75	2,700	1,078	494
		SS	II+	1	346		346	0.02	7/9/74	2,700	500	494

Table 11. (Con't.) Gill Net Results and Stocking Histories of Managed Lakes, Matanuska-Susitna Valleys, 1976.

Lake	Date Sampled	Species*	Age Class	n	Length (mm) $\bar{x}$	$\pm$ SD	Range	Catch/ Net Hr.	Date Stocked	Total Number	Per Gr.	Per Hectare
Harriet	12/7/76	GR	0+	3	173	9.71	162-181	0.14	6/25/76	8,400	Fry	2,298
		GR	1+	1	278		278	0.05	6/25/75	8,500	Fry	2,323
Meirs	12/9/76	GR	0+	14	161	4.57	153-171	0.36	6/25/76	10,000	Fry	1,544
		GR	1+	25	273	10.04	255-296	0.64	6/25/75	10,000	Fry	1,544

* Key: RT = rainbow trout; SS = coho salmon; GR = Arctic grayling; DV = Dolly Varden.

Table 12. Total Chinook Escapement in East Side Susitna Tributaries and Tributaries of the Chulitna and Talkeetna Rivers, 1972-1976.

Year	Observed Counts	Expanded Counts**
1972*	1,775	2,300
1973	8,086	8,900
1974	3,556	4,100
1975	1,247	1,500
1976	16,753	19,900

* Does not include Prairie Creek.

** Based on 100% efficiency of foot counts, 55% efficiency of fixed-wing counts in heavily wooded areas, and 70% efficiency of fixed-wing counts in alpine areas.

With the exception of Moose and Sheep creeks, all surveyed streams revealed 1976 escapement levels substantially higher than any previous year (Table 13). Willow and Montana Creeks have been surveyed by boat and on foot since 1969. The 1976 chinook salmon escapement on Willow Creek was 1,660 which is 273% higher than the past seven year average of 445. The 1976 escapement on Montana Creek was 1,445 chinook which is 492% higher than the past seven year average of 244.

There are no explanations as to why chinook escapements increased so dramatically in Susitna River tributaries. Chinook carcasses were examined for sex and size composition on four major chinook streams to determine the age structure of the escapement populations. Tables 14, 15, 16, and 17 contain all data obtained from chinook carcasses collected in Willow Creek, Montana Creek, Chulitna River, and Prairie Creek.

In Willow Creek a sample of 261 chinook carcasses had a mean length of 103.2 ± 10.49 cm. Males and females averaged 108.1 and 98.3 cm in length, respectively, and the male to female sex ratio was 1:1. Age composition determined by length frequencies indicated 1.5% were age 1.2, 21.1% were age 1.3, and 77.4% were age 1.4 (Table 14).

In Montana Creek a sample of 151 chinook carcasses had a mean length of 102.3± 11.79 cm. Males and females averaged 106.2 and 98.4 cm in length, respectively, and the male to female sex ratio was 1:1. Age composition indicated 4.0% were age 1.2, 19.9% were age 1.3, and 76.1% were age 1.4 (Table 15).

The chinook carcass data collected on Willow and Montana Creeks are nearly identical in all aspects indicating that the 1976 escapement populations are very similar. Figure 7 depicts length frequency by percent of chinook carcasses collected in Willow and Montana creeks. Over 75% of the chinook escapement in both streams were six-year-old fish which originated from the 1970 brood year of 640 and 161 chinook in Willow and Montana Creek, respectively.

A total of 146 chinook carcasses were sampled on the middle fork of Chulitna River. The fish had a mean length of 97.3 ± 9.48 cm. The sex ratio of males to females was 0.9:1 and males averaged 102.4 cm while females average 92.6 cm in length. Age composition indicated 2.1% were age 1.2, 41.1% were age 1.3, and 56.8% were age 1.4 (Table 16).

A sample of 339 chinook carcasses from Prairie Creek had a mean length of 91.0 ± 24.23 cm. Males averaged 81.4 cm and females 99.6 cm and the male to female sex ratio was 1.1:1. Age composition indicated 1.2% were age 1.1, 26.3% were age 1.2, 23.0% were age 1.3, and 49.5% were age 1.4 (Table 17).

The carcass data from Chulitna River and Prairie Creek reveal that although six-year-old chinook dominated, there were also a large number of five-year-old chinook present in the Chulitna River sample and equal numbers of four and five-year-old chinook present in the Prairie Creek sample. The relative strength of the brood years is unknown for both

Table 13. Observed Chinook Escapement Counts, Susitna River Tributaries, 1969-1976.

Stream	Ground Surveys							
	1969	1970	1971	1972	1973	1974	1975	1976
Willow Creek	290	640	165	370	1,074	402	177	1,660
Montana Creek	150	161	44	317	527	280	229	1,445
Moose Creek		126	40	21	36	32	55	116
Prairie Creek					4,190	1,498	369	6,513
	Aerial Surveys*							
	1969	1970	1971	1972	1973	1974	1975	1976
Chunilna Creek	375	58*	5*	91	245(292)	236(283)	(101)	1,220(1,237)
Kashwitna River (North Fork)	0		1	31	145(183)	103(85**)	(33)	(303)
Little Willow Creek		45**		99	233(371)	109(139**)	(103)	(833)
Sheep Creek				101	444(482)	202	42	394 (455)
Indian River				35	110(122)	102	31	537
Portage Creek				68	153(174)	260	32	702
Chulitna River (East Fork)					41 (42)	41	7	112
Chulitna River (Middle Fork)					206(219)	159	55	1,870
Chulitna River (Main Stem)								124
Prairie Creek		820		630	(3,286)			
Goose Creek						41	13	160
Little Susitna River					(374)			(405)
Honolulu Creek								24
Byers Creek								53
Troublesome Creek								92
Bunco Creek								112

* Helicopter surveys in parenthesis - all other counts fixed wing aircraft.
** Poor counting conditions.

Table 14. Age and Length Data from Chinook Carcasses, Willow Creek, 1976.

	Male Length (cm)				Female Length (cm)				Total Combined Sexes			
Age	n	%	$\bar{x}$	$\pm$ SD	n	%	$\bar{x}$	$\pm$ SD	n	%	$\bar{x}$	$\pm$ SD
1.2	3	2.3	65.3	4.93	1	0.8	64.0		4	1.5	65.0	4.08
1.3	10	7.6	92.5	2.01	45	34.6	91.2	3.43	55	21.1	91.5	3.24
1.4	118	90.1	110.5	7.58	84	64.6	102.5	4.43	202	77.4	107.2	7.54
Total	131	100.0	108.1	10.87	130	100.0	98.3	7.41	261	100.0	103.2	10.49

Table 15. Age and Length Data from Chinook Carcasses, Montana Creek, 1976.

	Male Length (cm)				Female Length (cm)				Total Combined Sexes			
Age	n	%	$\bar{x}$	$\pm$ SD	n	%	$\bar{x}$	$\pm$ SD	n	%	$\bar{x}$	$\pm$SD
1.2	4	5.3	66.8	3.86	2	2.7	75.0		6	4.0	69.5	5.20
1.3	10	13.1	90.8	3.79	20	26.7	89.0	5.70	30	19.9	89.6	5.15
1.4	62	81.6	111.2	6.63	53	70.6	102.8	4.47	115	76.1	107.3	7.10
Total	76	100.0	106.2	13.17	75	100.0	98.4	8.64	151	100.0	102.3	11.79

Table 16. Age and Length Data from Chinook Carcasses, Chulitna River, 1976.

	Male Length (cm)				Female Length (cm)				Total Combined Sexes			
Age	n	%	$\bar{x}$	$\pm$ SD	n	%	$\bar{x}$	$\pm$ SD	n	%	$\bar{x}$	$\pm$ SD
1.2	1	1.4	66.0		2	2.6	68.5	7.77	3	2.1	67.7	5.68
1.3	10	14.3	89.5	4.55	50	67.1	90.1	4.53	60	41.1	90.0	4.50
1.4	59	84.3	105.2	5.89	24	30.3	99.8	2.51	83	56.8	103.6	5.69
Total	70	100.0	102.4	9.05	76	100.0	92.6	7.22	146	100.0	97.3	9.48

Table 17. Age and Length Data from Chinook Carcasses, Prairie Creek, 1976.

	Male Length (cm)				Female Length (cm)				Total Combined Sexes			
Age	n	%	$\bar{x}$	$\pm$ SD	n	%	$\bar{x}$	$\pm$ SD	n	%	$\bar{x}$	$\pm$ SD
1.1	4	2.3	36.3	2.21					4	1.2	36.3	2.21
1.2	89	50.6	66.6	3.77					89	26.3	66.6	3.77
1.3	30	17.0	88.1	4.84	48	29.4	91.9	2.35	78	23.0	90.5	3.95
1.4	53	30.1	105.8	5.85	115	70.6	102.7	3.95	168	49.5	105.5	23.97
Total	176	100.0	81.4	19.14	163	100.0	99.6	6.08	339	100.0	91.0	24.23

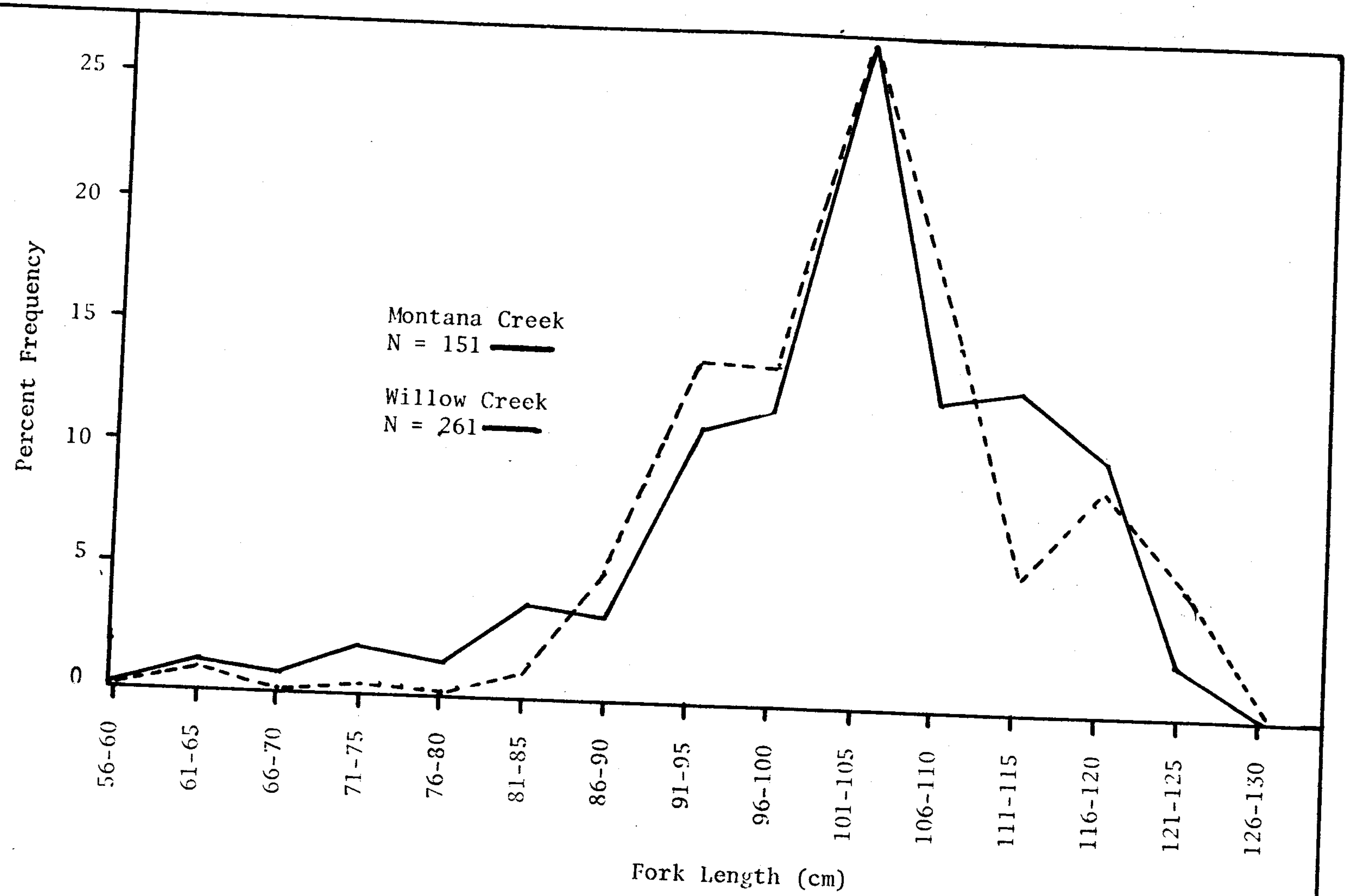

Figure 7. Length Frequency by Percent of Chinook Salmon Carcasses, Montana and Willow Creeks, 1976.

these populations since surveys were not conducted during those years. Length frequency by percent for chinook carcasses collected in Chulitna River and Prairie Creek is shown in Figure 8.

Coho Studies:

Foot surveys were conducted in escapement index areas on seven streams to estimate spawning coho salmon populations.

A summary of coho escapement counts in index areas is presented in Table 18. An additional index area was established on Wasilla Creek which lengthens the original index by two miles.

A total of 151 coho were observed in Wasilla Creek index area (a) which is the highest recorded escapement since counts began in 1970. Wasilla Creek index area (b) contained 162 spawning coho. As in 1975, fishing success in the lower portion of Wasilla Creek was high during the week-ends when a portion of the stream was open to salmon fishing. Watsjold (1975) stated that the 1976 escapement would probably be poor based on the low parent year escapement in 1972. It is possible that the parent year escapement in 1972 was distributed in areas other than the index area. Watsjold noted that water fluctuations appear to have an important influence on spawning distribution in Wasilla Creek. This was the primary reason for adding an additional two miles upstream of the original index area.

A total of 100 coho were enumerated in the Cottonwood Creek index area. This is the highest escapement in this area since counts began in 1968. An additional 104 coho were observed in several other spawning areas interspersed between various lakes in the drainage. Salmon fishing was closed in 1976 by emergency order because of poor angling success in the area open to salmon fishing. The closure may have been responsible for increased escapement.

Coho escapement into Birch Creek has been steadily declining, and in 1976 the escapement was the lowest on record since initiation of counts in 1968.

A total of 764 coho were enumerated through the weir on Fish Creek in 1976 which closely proximates the parent year escapement of 716 coho in 1972. A total of 224 coho were enumerated in the Fish Creek index area and an additional 255 coho were observed from the index area downstream to the Knik-Goose Bay Road. Fish Creek was also closed to salmon fishing by emergency order.

Each year the Fish and Meadow creeks index area counts are compared to the weir counts to evaluate the effectiveness of index counts. Table 19 shows the percent of the total weir count of coho that were observed in the index areas. The Meadow Creek escapement count of 102 coho in the index area was believed to be abnormal since the normal upstream migrational pattern of coho was interrupted by a weir installed by the Fisheries Rehabilitation and Enhancement Division. The weir was placed across Meadow Creek to collect coho eggs. Several days before escapement

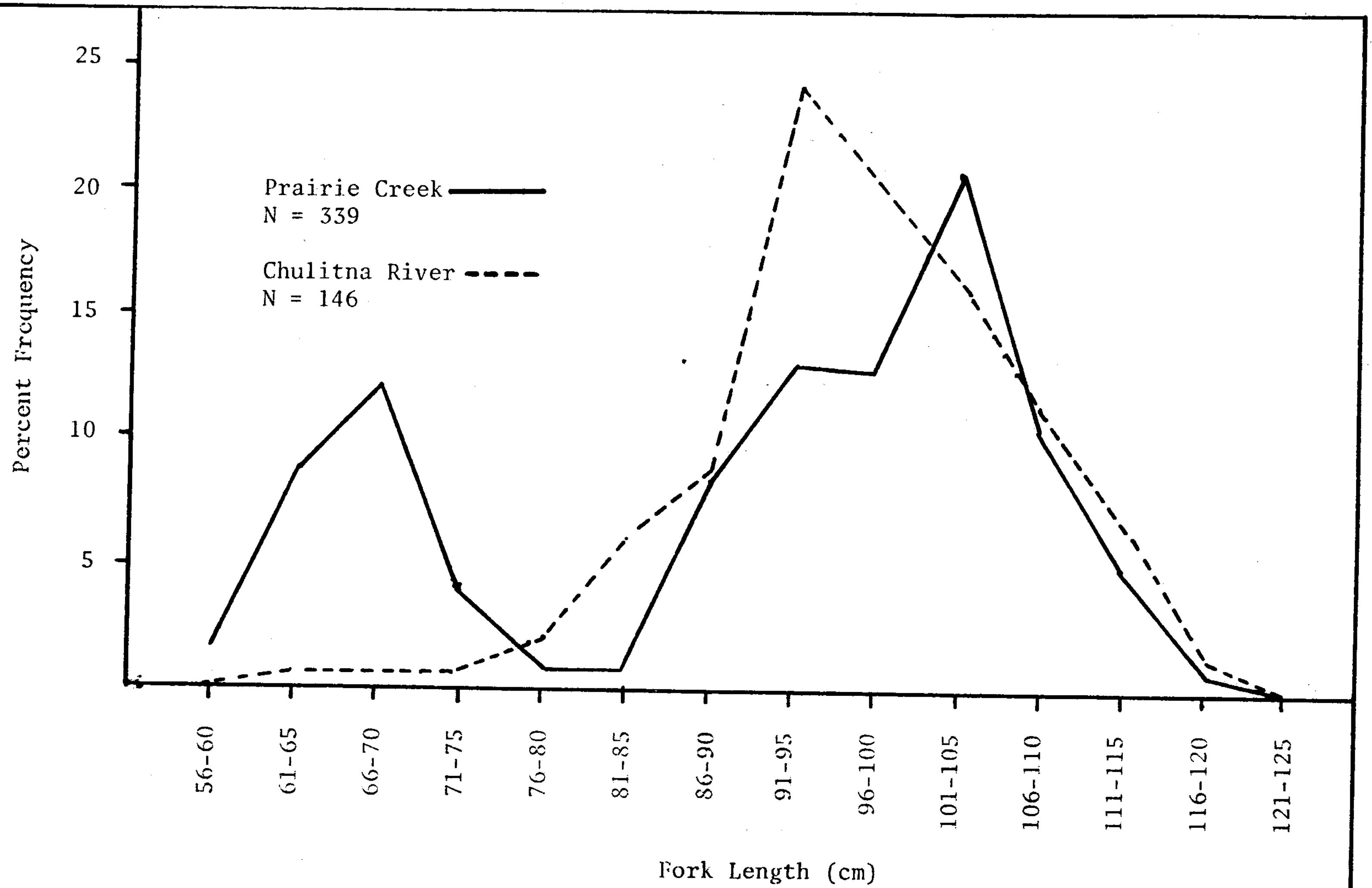

Figure 8. Length Frequency by Percent of Chinook Salmon Carcasses, Prairie Creek and Chulitna River, 1976.

Table 18. Numbers of Coho in Escapement Index Areas (Foot Counts), Upper Cook Inlet, 1968-1976.

Stream	1968	1969	1970	1971	1972	1973	1974	1975	1976	Average 1968-75
Wasilla (a)			101	104	19	28	30	49	151	55
Wasilla (b)			94					158	162	
Cottonwood	22	9	5	29	21	10	2	73	100	21
Birch	125	142	206	138	69	106	49	92	27	116
Fish		852	176	141*	118	75	256	455*	224	296
Meadow	54	109	49	9	27	14	22	7	102**	
Question						59	3	111	126	58
Rabideux								67	91	67
Total	201	1,112	631	421	254	292	362	1,012	983	

* Due to high water a boat count was necessary.

** Normal spawner distribution was affected by interruption of normal migrational pattern.

Table 19. Evaluation of Fish and Meadow Creeks Coho Index Areas, 1969-1976.

Year	Dates of Operation	Weir Counts	Fish Creek Index Area	% of Weir Count	Meadow Creek Index Area	% of Weir Count
1969	7/14-9/2	4,253	852	20.0	109	2.6
1972	7/2-9/8	716	118	16.5	27	3.8
1973	7/1-9/6	210	75	35.7	14	6.7
1974	7/8-9/6	1,154	256	22.2	22	1.9
1975	7/3-9/11	1,601	455	28.4	7	0.4
1976	7/5-9/11	765	224	29.3		

counts were conducted this weir had washed out releasing those coho which were in spawning condition upstream. The coho may have commenced spawning in the nearest available spawning area rather than move up into spawning areas high in the drainage.

Length-weight data were collected from sport caught fish on Wasilla Creek and Little Susitna River (Table 20). Data from Fish Creek were collected at the weir site. The data reveal that Wasilla and Fish Creek coho are very similar. Coho from Wasilla Creek averaged 58.7 ± 4.59 cm in length while Fish Creek coho averaged 59.5 ± 5.97 cm. Weights revealed that coho averaged 3.58 ± .78 kilograms (4.8 ± 1.15 pounds) in Wasilla Creek and 2.13 ± .67 kilograms (4.7 ± 1.48 pounds) in Fish Creek. Little Susitna River coho were much larger, averaging 67.0 ± 5.20 cm in length and weighing 7.9 ± 1.72 pounds. Figure 9 depicts length frequency of coho sampled from the three streams.

DISCUSSION

Results of minnow trapping show that catch rates for salmonids were much higher during the winter months than were recorded during the summer period. The higher winter catch rates do not necessarily indicate that winter salmonid populations increased through recruitment from other areas of the watershed. The increase may primarily have been due to different trapping conditions during the two seasonal periods. Longer hours of darkness and ice cover could be responsible for higher winter catch rates. Traps set under the ice had to be located where adequate water depths occurred which means that traps were primarily placed in pools or portions of the stream that had low gradient and higher average depths. It is likely that these areas are utilized most frequently by rearing fish which are probably confined to the deeper water areas where they have adequate food and space. This confinement would create densities that are higher than what would be found during the summer period in the same deep water areas. Greater attraction to the bait eggs may also occur in the winter due to a paucity of food. Since Fish Creek contains numerous riffle and pool environments this condition would be most notable in Index #1-3; whereas, in Index #4 on Meadow Creek the pool-riffle condition is not typical, allowing for a more random placement of traps. Any significant change in catch rates on Meadow Creek would indicate a movement of fish within the Meadow Creek drainage.

The summer and winter catch rates do indicate the population densities of salmonids in all index areas remain relatively equal throughout the year. Undoubtedly there are continued seasonal shifts in different age groups of all species.

There is little doubt that sticklebacks and cottids do not utilize the streams during the winter months. These species, although extremely abundant during the summer period, were almost non-existant in the lower portion of Fish Creek during the winter period. Their numbers were substantially reduced throughout the remainder of Fish Creek and in Meadow Creek during winter months. Data collected from the smolt weir since 1973 indicate that there is a massive migration of sticklebacks out of

Table 20. Coho Salmon Length Weight Data Collected from Three Streams, 1976.

Stream	Length (cm) n	$\bar{x}$	$\pm$ SD	Weight (lbs.) n	$\bar{y}$	$\pm$ SD
Wasilla Creek						
Male	53	60.1	5.11	53	5.0	1.30
Female	54	57.4	3.58	54	4.5	0.92
Combined Sexes	107	58.7	4.59	107	4.8	1.15
Fish Creek						
Male	60	58.2	6.22	60	4.4	1.54
Female	41	61.2	5.16	41	5.3	1.21
Combined Sexes	101	59.5	5.97	101	4.7	1.48
Little Susitna River*						
Male	48	68.5	5.12	40	8.1	1.96
Female	24	64.1	3.94	19	7.4	0.87
Combined Sexes	72	67.0	5.20	59	7.9	1.72

* Weights were not recorded for coho that had been cleaned and no sex was recorded for two coho.

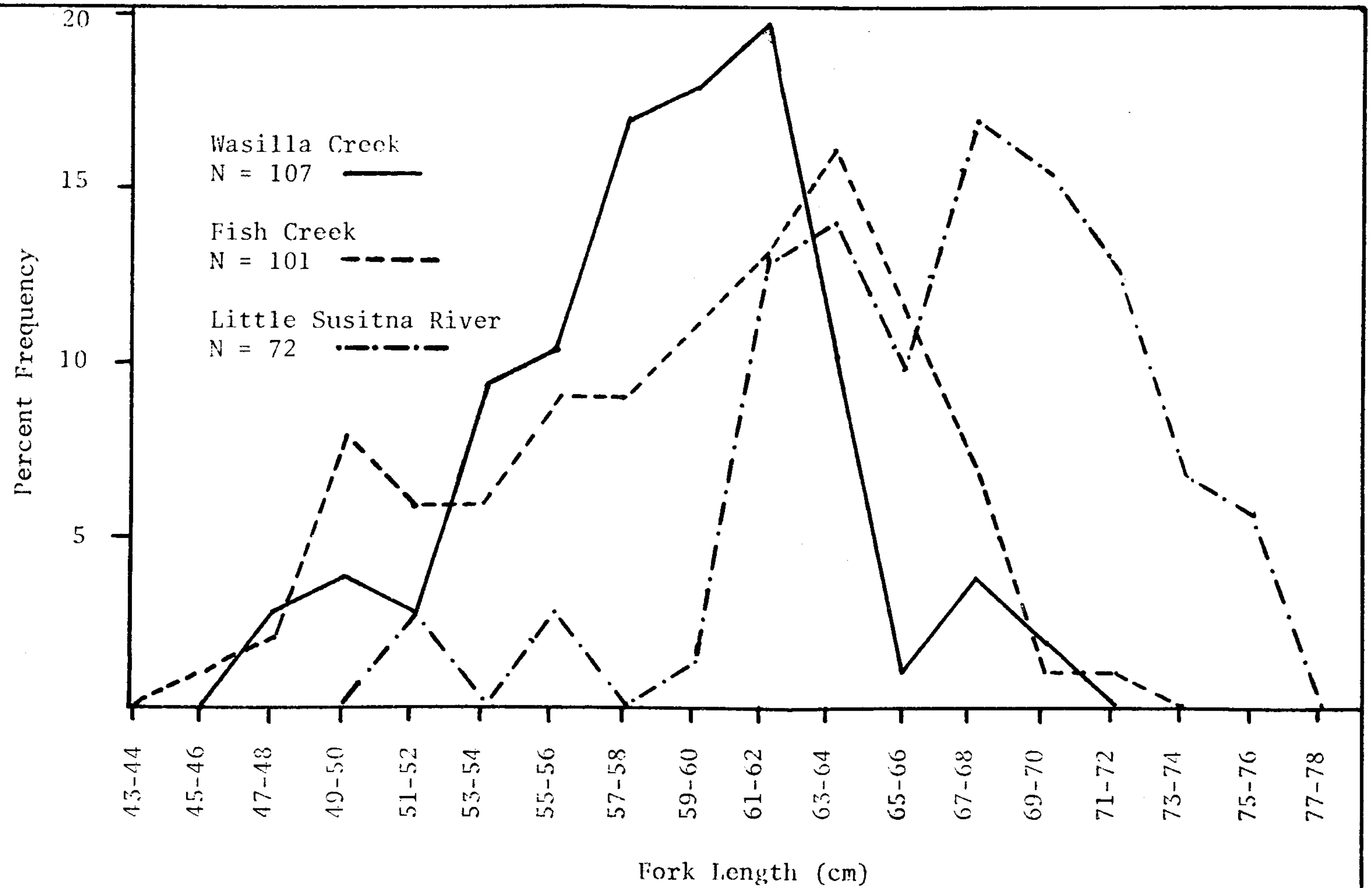

Figure 9. Length Frequency by Percent for Coho Salmon in Wasilla Creek, Fish Creek and Little Susitna River, 1976.

Big Lake during May and June. There is also a migration of cottids occurring during the same period. This explains the high densities of these species during the summer months. It is unknown whether these species return to Big Lake or whether their life cycles terminate in the stream during the fall period, thus reducing their numbers substantially by winter.

Trapping data indicate that the highest density of salmonids is found in Index #3. This may be due to a number of factors. During their spawning periods the highest densities of adult coho and rainbow are found in Index #3, thus the densities of age 0+ salmonids would be highest in this area. Since Index #3 is immediately below Big Lake, food organisms may be more abundant than elsewhere and water temperatures and flows more stable, allowing for favorable rearing conditions. There is a strong possibility that the outlet control structure on Big Lake, which is considered at times to be a velocity barrier to young fish, is prohibiting age 0+ coho from migrating into Big Lake.

During November 1976 when trapping was being conducted in Index #3, coho catch rates exceeded 6.0 fish/hour in the area between the control structure and just below the smolt site. Eighty-seven percent of the coho were age 0+. On February 14, 1977 coho catch rates in the same area were 4.9 fish/hour and again 87% were age 0+.

Summer catch rates of age 1+ rainbow in Index #3 were nearly the same as recorded for age 0+ coho, yet winter catch rates of age 1+ rainbow in the area between the control structure and weir site had declined to 0.16 fish/hour by November, 1976 and were only 0.03 fish/hour in February, 1977. Rainbow that normally inhabit the same area as coho were not present in this area of Index #3 during the winter months, indicating that those coho may have been backed up below the control structure. It was also noted that during the winter period coho were moving in schools of 50 to 100 fish, which is not typical rearing coho behavior.

These factors tend to indicate that the control structure may be effectively limiting upstream movement of age 0+ salmonids. During the summer of 1976 thousands of sockeye fry were backed up below the control structure and had to be lifted over the structure to enable them to get into Big Lake.

Summer and winter catch rates strongly indicate that age 1+ rainbow trout either migrated from Index #3 downstream into Index #1 and #2 for winter rearing or those rainbow inhabiting Index #3 moved upstream into Big Lake. Velocities at the control structure may not impede migration of age 1+ salmonids. This movement is also reflected by a change in species composition within Index #3. During the summer, rainbow comprised 44.3% of the salmonid population in Index #3; but by winter, rainbow accounted for only 26.6% of the salmonid catch in this area. During the summer months 61.7% of all rainbow captured were from Index #3 but by winter only 36% of the rainbow caught were from Index #3. Catch rates of age II+ rainbow were much lower in the winter than during the summer in all areas, which indicates that they may have moved into the lotic environment.

Rainbow trout studies were conducted from 1956-1958 by the U.S. Fish and Wildlife Service in Cottonwood Creek, which is part of a large drainage of lakes similar to the Big Lake drainage. These studies revealed migrational patterns of rainbow trout in Cottonwood Creek which may be applicable to rainbow in Fish Creek. The Cottonwood Creek studies showed that a downstream movement of rainbow occurred in April and May, generally peaking on May 15. This migration out of Wasilla Lake was comprised of the spawning population and a large number of nonspawning rainbows ranging in length from 75 to 125 mm.

A similar migration has been recorded at the smolt weir on Fish Creek since 1973 when the weir was installed. This migration from Big Lake occurs in May and early June, although an unknown number may migrate before that period since the weir is not operational until early May. Although no measurements have been taken, this migration contains the spawning population as well as large numbers of small nonspawning rainbow. Two obvious upstream migrations have been recorded on Cottonwood Creek each year the study was conducted. The first two weeks in June small rainbow that had migrated downstream with the spawners moved back up into the lake system. The second migration occurred in July and the first week in August. This migration consisted of age I+ and II+ rainbow trout that were moving into the lake for the first time. This substantiates the general belief that rainbow typically spend their first year or two in the stream environment to avoid intense competition with species which generally inhabit the lake environment. The Cottonwood Creek studies also revealed that fish movement in the stream had ceased by the end of September and very little movement of salmonids occurred under the ice.

There is also an indication that coho may have migrated out of the headwater lakes of Meadow Creek and/or emigrated upstream from Big Lake. Summer and winter rainbow catch rates were nearly identical in Index #4 while winter coho catch rates increased substantially in this area. Coho accounted for 64.6% of the winter salmonid catch in Index #4 compared to 50.2% during the summer period.

Both summer and winter sampling in the Meadow Creek index area revealed relatively few age 0+ coho, whereas this age class predominated in Fish Creek during summer and winter. Movement of age 0+ Meadow Creek coho to lentic rearing areas with a subsequent return to lotic water at an older age appears likely.

A sockeye enumeration experiment adjacent to the Meadow Creek incubation facility during early summer suggested an upstream movement of juvenile coho from Big Lake. Neither the magnitude or duration of this movement was estimated because the study was directed toward downstream migrants. Similar upstream movements of juvenile coho have been recorded but never quantified for other Matanuska Valley streams.

It is also known that eutrophication of several lakes at the headwaters of Meadow Creek has been occurring at a rapid pace which has resulted in extremely low winter dissolved oxygen levels during some years. Such harsh winter conditions may force salmonids that were rearing in these lakes during summer months to move downstream into Meadow Creek for winter rearing.

Downstream migration of coho in Fish Creek is recorded at the smolt site and generally peaks during the first two weeks of June. This migration consists of age I, II and III coho. Age II and III coho are undoubtedly smolting but it is not known what percentage of the age I coho are smolting or if they are just moving into Fish Creek to rear. From 42% to 60% of this migration are age II coho and 28% to 37% are age III. Age I coho have accounted for 8% to 30% of the migration during the last several years. It is probable that the majority of the age I coho are not smolting. These migrants are almost identical in size to age I coho that are normally rearing in Fish Creek.

Coho growth data collected during the summer months may be somewhat misleading. Numerous studies of coho behavior have demonstrated that aggressive behavior among coho is nearly continuous during the period from emergence of fry until fall. Chapman (1962) conducted a study on the aggressive behavior in juvenile coho salmon. He concluded that aggressive behavior is one important factor causing downstream movement of coho fry. His study revealed that coho fry move downstream from shortly after emergence through early fall, and this downstream movement does not cease until the fry find sufficient space free of resident coho. Upstream movement of fry was negligible. This behavior would tend to cause the density of resident coho per unit area to remain rather constant each year if sufficient numbers of coho are available to utilize all existing rearing areas. Chapman stated that this aggression accounts for part of the considerable range in sizes of coho at a given time. Some of the variability in size stems from varying emergence times and varying sizes at emergence of fish emerging at the same time.

Mason (1976) concluded that survival, growth, and biomass yield were inversely related to stocking density in coho populations. His findings clearly illustrate that overstocking of young coho in rearing streams stimulates out-migration of the smaller fish and appears to result in slower growth and reduced survival of resident fish. His study also shows that the winter carrying capacity of a stream is a primary limiting factor to increasing potential smolt yield.

The above factors make it difficult to interpret the length data collected in each index area during the summer months since differences in size may be a function of growth rates or behavioral characteristics or a combination of both. If the sampling program had not been limited to a particular time period these problems could be somewhat avoided through a more efficient sampling design. Age determinations of large salmonids during the winter revealed that age composition of sample sizes of retained salmonids did not reflect the true age composition in each index area.

The age data are not representative of the actual age composition in each index area. Apparently the sample size from each trap was insufficient, thereby causing biased results. More rainbows were kept than coho, even though coho were the dominant species in most index areas.

The person collecting the daily samples from each trap may have been selecting larger fish even though he was not aware of doing so. It may be that rainbow and larger size coho, because of their aggressive behavior, entered the trap immediately after the trap was set. The entire sample was always taken out of the trap after the first check. This bias can easily be eliminated by collecting more samples at varying times throughout the 24-hour period.

It definitely appears that conditions in Index #4 are more favorable for rearing salmonids than any of the other index areas. Average sizes of all ages of salmonids are consistantly higher in Index #4 which indicates that either growth rates are greater for fish rearing in this area or that larger dominant individuals are seeking out the best rearing areas which are located in Index #4. Movements from lotic to lentic environments may also influence growth in this area. It is probable that differences in sizes are due to a combination of many factors.

The age and growth data for summer and winter months do show that age I+ rainbow have a faster growth rate than age I+ coho. Age 0+ rainbow, which emerge considerably later than age 0+ coho, appear to grow very rapidly and by the winter period age 0+ rainbow are nearly the same length as the age 0+ coho.

Upon examination of scales it was clearly much easier to interpret rainbow ages than it was for coho. Aging of all salmonids was no problem during the summer period. Upon examination of coho scales collected during the winter it was obvious that many coho had been moving to different areas in the system sometime between the summer and winter periods. Circuli formation was very erratic and it appeared that some coho were moving from less desirable rearing areas to more desirable areas, or in some cases, may have moved from a lake environment into a stream environment. This problem was never encountered when examining rainbow scales, indicating that rainbow movement may be minimal once they take up residency in the stream. Coho scales collected in February 1977 had as many as six additional circuli after the present winter annulus formation. This rapid increase in growth during this time period has not been explained.

There are definite relationships between water velocities and species composition. Catch rates of coho were highest in sluggish waters (0.60 fish/hour) and lowest in swift waters (0.23 fish/hour). Rainbow exhibited exactly the opposite, with catch rates of 0.59 fish/hour in swift water and 0.29 fish/hour in sluggish waters. Sticklebacks were found most frequently in sluggish waters, while cottids were primarily inhabiting moderate velocity waters. To determine whether there is a statistical difference between catch rates of salmonids in various water velocities a test was conducted to disprove the null hypothesis that there is no difference in catch rates in different velocity waters. This null hypothesis was rejected based on an analysis of variance F-test which means that there is a statistical difference in catch rates of salmonids in the four categories of water velocity.

Bottom types at each trap site were also recorded. Generally the data reveal that salmonids preferred sand and/or gravel bottom types. The highest concentrations of sticklebacks were always found where sandy bottoms existed while cottids appeared to have no particular preference. It was obvious that species composition in an area was more dependent on water velocities than on bottom types.

The Fish and Meadow creeks investigation, while being very inconclusive, has raised a considerable number of questions that can be answered by further study. The project was initially designed to determine how effective minnow trapping would be in a study such as the one conducted. Such studies are primarily conducted utilizing a number of weirs and impoundments which are very costly to operate and maintain. It appears that minnow traps are a highly efficient sampling tool if utilized properly. The initial year of sampling has provided an enormous insight into how to utilize minnow traps effectively to obtain the necessary data needed to interpret growth rates, migrational trends, and habitat preferences.

Preliminary surveys conducted in the Caswell Lake drainage indicate that this system may very well benefit from enhancement efforts. Probably the primary reason that led to a decline in coho production in the system was the increased beaver population along the drainage. There is now only a remnant coho run in the area which without some assistance will never increase. Rearing areas appear to be plentiful but spawning areas are minimal, having been covered up by debris settling in the extensive pool areas created by beaver dams.

Chinook salmon populations in all surveyed streams of the east side Susitna, Talkeetna and Chulitna tributaries were the highest ever recorded despite low parent year escapements. Carcass data show that the age and length structure of chinook salmon populations in Willow and Montana creeks were almost identical, but these populations differed from those found in Talkeetna and Chulitna River drainages.

Coho escapement counts revealed populations are being maintained in some stream systems but are still declining in others. Coho lengths and weights indicate that coho in Knik Arm systems average from 58 to 60 cm in length and weigh 4.7 to 4.8 pounds. Little Susitna River probably contains the largest size coho found in the Matanuska-Susitna Valleys. These coho average 67 cm in length and weigh an average of 7.9 pounds.

Subdivision proposals along waterways that have been submitted to the Borough for approval have been reviewed and recommendations made. Negotiations are underway to purchase a five acre tract of land at the confluence of Sheep Creek and the Susitna River which is an area heavily utilized by salmon fishermen. Questions about access are currently being dealt with by the Habitat Section of the Department of Fish and Game.

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